

14 Urn models and applications

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Description: An urn contains a number of balls of different types (colours), changing successively over time, typically drawing a ball from the urn and returning it together with some further balls of colours depending on the colour drawn. The simplest case of two colours and each time adding one extra ball of the colour drawn is the classical Pólya urn model, a nice application of martingale methods, which is treated in textbooks such as Feller. There is a wide literature on further developments, more recent contributions by Janson and by Chauvin et al. give overviews that can lead the direction for this project. Applications include Dirichlet processes with connections to Bayesian statistics and reinforced random walks and other interacting urn models of relevance in Biology and Economics.

References:

- B. Chauvin, N. Pouyanne, R. Sahnoun: 'Limit distributions for large Pólya urns'. *Annals of Applied Probability*, Vol. 21 (2011), No. 1, 1–32.
- W. Feller: *An introduction to probability theory and its applications*. Vol. 2. Wiley 1968.
- S. Janson: 'Limit theorems for triangular urn schemes'. *Probability Theory and Related Fields*, Vol. 134 (2006), 417–452.
- R. Pemantle: 'A survey of random processes with reinforcement'. *Probability Surveys*, Vol. 4 (2007), 1–79.

Prerequisites: BS3a *Applied Probability*. B10a *Martingales through Measure Theory*.

Type: Project with possibilities for theoretical study, possibly simulation.